

THE PRESENCE OF THE GENUS *COCCONEIS* EHRENBERG (BACILLARIOPHYCEAE) IN FRESHWATER BODIES OF CUBA

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ABSTRACT — Three taxa of *Cocconeis* Ehrenberg are characterized and illustrated from 29 samples collected in 28 freshwater bodies of Cuba. *C. placentula* var. *lineata* (Ehrenberg) Van Heurck was very common, while *C. placentula* var. *euglypta* (Ehrenberg) Grunow and *C. placentula* var. *pseudolineata* Geitler, occurred less frequently. The latter is reported for the first time from Cuba.

RÉSUMÉ — Trois taxons de *Cocconeis* Ehrenberg sont décrits et illustrés à partir de 29 échantillons d'eau douce pris dans 28 localités à Cuba. *C. placentula* var. *lineata* (Ehrenberg) Van Heurck est le plus répandu tandis que la distribution de *C. placentula* var. *euglypta* (Ehrenberg) Grunow et *C. placentula* var. *pseudolineata* Geitler est plus limitée. Ce dernier est signalé pour la première fois à Cuba.

RESUMEN — Se describe e ilustra 3 taxa de *Cocconeis* Ehrenberg a partir de 29 muestras de agua dulce recolectadas en 28 localidades de Cuba. *C. placentula* var. *lineata* (Ehrenberg) Van Heurck resultó el más común, mientras que *C. placentula* var. *euglypta* (Ehrenberg) Grunow y *C. placentula* var. *pseudolineata* Geitler tienen una distribución más limitada. El último, es señalado por primera vez para Cuba.

KEY WORDS — Bacillariophyceae, *Cocconeis*, new record, distribution, Cuba.

INTRODUCTION

Information about the diatoms of Cuba is rather scanty. Margalef (1947) mentions the occurrence of 20 taxa collected in Laguna de Ariguanabo (Isla de Pinos, presently Isla de la Juventud). The author identified over 10 species, however no illustrations were included. At present, the work of Foged (1984) is considered the most comprehensive report on the diatoms of Cuba. His samples were obtained from localities in the western half of the country. He reported a total of 568 taxa, including 207 from freshwater bodies and 361 from marine sites. Maldonado & Genes (1986) identified and

provided illustrations of 41 taxa from 15 freshwater bodies of the Province of Pinar del Río, Habana, Cienfuegos and of the Municipio Especial de la Isla de la Juventud. Maldonado (1987) briefly described and illustrated 14 taxa from Laguna de Mina Iberia, Baracoa, Provincia de Guantánamo. Toledo (1989, 1992a, 1992b) identified 150 freshwater taxa in samples from Estanque del Jardín Botánico de Cienfuegos, Municipio Especial de la Isla de la Juventud, and from Provincia de Camagüey. These reports include comments about the taxonomy, distribution, as well as illustrations and measurements of some of the species found.

In the previous reports cited above only four freshwater *Cocconeis* Ehrenberg taxa are mentioned; these include *C. placentula* Ehrenberg, *C. placentula* var. *euglypta* (Ehrenberg) Grunow, *C. placentula* var. *lineata* (Ehrenberg) Van Heurck and *C. fluvialis* Wallace. The present contribution informs about the occurrence and characterization of 3 taxa for the genus *Cocconeis*: *C. placentula* var. *pseudolineata* Geitler, not previously reported; and *C. placentula* var. *lineata* (Ehrenberg) Van Heurck and *C. placentula* var. *euglypta* (Ehrenberg) Grunow, with an enlarged distribution.

MATERIALS AND METHODS

All samples studied are deposited at the *Colección de Muestras de Agua Dulce del Jardín Botánico de Cienfuegos*, Cuba. The genus *Cocconeis* was found in 29 samples from 28 freshwater localities (Fig. 1). The samples are described as they originally appear on the labels (mval/l = meq l⁻¹).

Municipio Especial Isla de la Juventud (Fig. 1, area n° 1):

M-88/17. "Presa Cristal; col. Dr A. Comas; 7/12/88; perifiton".

M-88/18. "Río en camino a Demajagua, debajo del puente; col. Dr A. Comas; 7/12/88; perifiton".

M-88/19. "Río en la carretera de Gerona a Demajagua, debajo del puente; col. Dr A. Comas; 7/12/88, perifiton".

Provincia Pinar del Río (Fig. 1, area n° 2):

M-73. "Charco en la carretera entre el Valle de Viñales y la ciudad de Pinar del Río (Km 18-19); col. Dr A. Comas; 16/3/77; perifiton; Temp. 26° C, ph 6.5".

M-76. "Charco en la carretera entre el Valle de Viñales y la ciudad de Pinar del Río (Km 11); col. Dr A. Comas; 16/3/77; temp. 27° C, ph 6.4".

M-88. "Presa Isabel Rubio; col. Dr A. Comas; 16/3/77; temp. 29° C, ph 7".

M-90. "Laguna San Juan; col. Dr A. Comas; 17/3/77; temp. 27° C, ph 7; perifiton".

M-94. "Valle San Juan, Finca La Jarreta; col. Dr A. Comas; 17/3/77; temp. 26° C, ph 7.3; plancton".

M-110. "Laguna Santa Barbara; 1977; perifiton; temp. 28° C, ph 6.8".

M-431. "Río entre el Valle de Viñales y la ciudad de Pinar del Río, debajo del puente; col. Dr A. Comas; 15/12/80".

M-432b. "Charco cerca del Motel Los Jazmines; col. Dr A. Comas; 15/12/80; perifiton".

M-87/1. "Charco en bosque frente a La Bajada, Guanahacabibes; col. Lic. V. Martínez; 8/6/87; perifiton".

M-87/5a. "Laguna Grande; col. Lic. V. Martínez; 9/6/87; perifiton; temp. 30° C, ph 9.3, conductividad 108 $\mu\text{S cm}^{-1}$, HCO₃⁻ [sic for HCO₃⁻] 0.36 mval/l, Ca²⁺ 0.44 mval/l, Mg²⁺ 0.22 mval/l, dureza total 0.66 mval/l, Cl 0.48 mval/l".

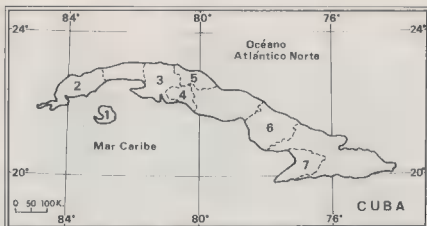


Fig. 1. Provinces from which samples were analyzed for *Cocconeis* taxa. N° 1: Municipio Especial Isla de la Juventud, 3 loc.; N° 2: Provincia Pinar del Río, 14 loc.; N° 3: Provincia Matanzas, 1 loc.; N° 4: Provincia Cienfuegos, 3 loc.; N° 5: Provincia Villa Clara, 1 loc.; N° 6: Provincia Camagüey, 2 loc.; N° 7: Provincia Granma, 4 loc.

M-87/6. "Laguna Vieja; col. Lic. V. Martínez; 10/6/87; perifiton; temp. 28° C, ph 7.4, conductividad 935 $\mu\text{S cm}^{-1}$, HCO_2 [sic for HCO_3] 3.15 mval/l, Ca^{2+} 2.6 mval/l, Mg^{2+} 1.94 mval/l, dureza total 4.53 mval/l, Cl^- 4.99 mval/l".

M-87/7. "Desviadero a Presa Cuyaguaje; col. Lic. V. Martínez; 10/6/87; perifiton; temp. 28° C, ph 6.8, conductividad 252 $\mu\text{S cm}^{-1}$, HCO_2 [sic for HCO_3] 1.62 mval/l".

M-87/8. "Laguna El Toro; col. Lic. V. Martínez; 10/6/87; perifiton; temp. 38° C, ph 7.2, conductividad 720 $\mu\text{S cm}^{-1}$, HCO_2 [sic for HCO_3] 0.65 mval/l, Ca^{2+} 1.01 mval/l".

M-87/9b. "Laguna Alcastráz Grande; col. Lic. V. Martínez; 10/6/87; temp. 30° C, ph 8.8, conductividad 234 $\mu\text{S cm}^{-1}$, HCO_2 [sic for HCO_3] 1.04 mval/l, Ca^{2+} 1.01 mval/l, Mg^{2+} 0.92 mval/l, dureza total 1.94 mval/l".

Provincia Matanzas (Fig. 1, ■■ n° 3):

M-479b. "Laguna del Tesoro, Ciénaga de Zapata; col. Dr A. Comas; 3/2/81; perifiton".

M-480a. "Mouth of the Laguna del Tesoro, Ciénaga de Zapata; col. Dr A. Comas; 3/12/81; perifiton".

Provincia Cienfuegos (Fig. 1, area n° 4):

[Unnumbered] "M-Río Lajas; Nov./83".

[Unnumbered] "M-Naranjito; Marzo/82".

[Unnumbered] "M-El Naranjo, Escambray; Mayo/82".

Provincia Villa Clara (Fig. 1, ■■ n° 5):

M-87/11. "Acueducto Viena; 1987".

Provincia Camagüey (Fig. 1, area n° 6):

M-86/18. "Río Saramaguacán, debajo del puente, a 9 Km de carretera hacia Playa Santa Lucia; col. Dr A. Comas y Dr Petr Marvan; 2/12/86; temp. 25.5° C, ph 8.4, alcalinidad 4.6 mval/l, Cl^- 2.4 mval/l, dureza total 2.8 mval/l, conductividad 847 $\mu\text{S cm}^{-1}$ ".

M-86/34. "Presa callejón de Carmen; col. Dr A. Comas and Dr Petr Marvan; 4/12/86, temp. 26° C, ph 7, alcalinidad 1.3 mval/l, Cl — 0.7 mval/l, dureza total 1.3 mval/l, conductividad 2.03 $\mu\text{S cm}^{-1}$ ".

Provincia Grannia (Fig. 1, area n° 7):

M-116. "Canal al lado del camino, Dormitorio Leonero; col. Dr A. Comas; 20/4/77; detritus; ph 7.5".

M-117b. "Arroyo cerca del camino entre Leonero y Puente Guillen; col. Dr A. Comas; 20/4/77; perifiton".

M — 124b. "Charco al lado de la carretera, Cayamas; col. Dr A. Comas; 20/4/77; detritus".

M-131b. "Canales en arrozceras, Manzanillo; col. Dr A. Comas; 21/4/77; detritus".

Organic matter of the frustules was removed using the method of Hasle & Fryxell (1970). Pleurax was the resin used for permanent mounting, and it was prepared at the Laboratorio de Cienfuegos according to the method of von Stosch (1974). Light microscopy observations were done using a Carl Zeiss Jena microscope, model Amplival (Cienfuegos), and a Carl Zeiss Standard RA microscope with phase contrast (Concepción). Photomicrographs were obtained with a Zeiss C 35 automatic camera, using 100 ASA (21 DIN) Kodak film.

OBSERVATIONS

Cocconeis placentula Ehrenberg var. *pseudolineata* Geitler Figs 2-9

Geitler, L., 1927: 515, figs 2c-f.

Krammer K. & Lange-Bertalot H., 1991: 87, pl. 54, figs 3-11.

Valves ovoid, 16.5-26 μm long and 10-15 μm wide. Valve with raphe-sternum with 10-13 striae in 10 μm ; areolae 20-24 in 10 μm ; 1 or 2 marginal areolae beyond the hyaline submarginal area. Valve with sternum has a narrow linear axial area; striae 10-13 in 10 μm ; areolae large, rectangular to quadrangular, usually forming irregular longitudinal lines. Each areola shows a more refringent rounded central area when viewed with the light microscope.

Distribution: under natural conditions, this taxon does not constitute dense populations; however, it is generally well represented in our samples. Found in: area n° 2 (M-431 and M-87/7); area n° 6 (M-86/18 and M-86/34).

Previously reported as *C. fluviatilis* Wallace by Toledo (1992b), from localities of Camagüey.

C. placentula Ehrenberg var. *lineata* (Ehrenberg) Van Heurck Figs. 10-14

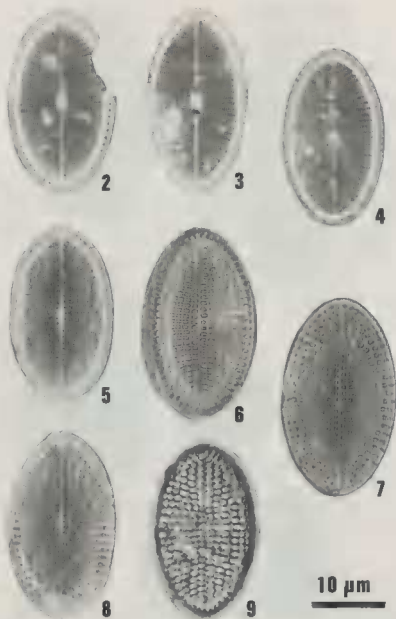
Basionym: *Cocconeis lineata* Ehrenberg 1843: 369.

Van Heurck H., 1885: 133.

Patrick R. & Reimer C.W., 1966: 242, pl. 15, figs 5-6.

Krammer K. & Lange-Bertalot H., 1991: 87, pl. 49, fig. 1; pl. 50, figs 1-13.

Valves ovoid, robust, 14-42 μm long and 9-27 μm wide. Valves with raphe-sternum have a linear and narrow axial area, and a small, generally ovoid to somewhat rhombic central area; striae 18-20 in 10 μm , those in the center almost parallel, changing



Figs 2-9, *Cocconeis placentula* (Ehrenberg) var. *pseudolineata* Geitler. Figs 2-4, valves with raphe-sternum. Figs 5-9, valves with sternum. Figs 2, 5, 7-9, M-87/7 Provincia Pinar del Río. Figs 3-4, M-431 Provincia Pinar del Río. Fig. 6, M-86/34 Provincia Camagüey. Scale 10 µm.



Figs 10-14. *Cocconeis placentula* (Ehrenberg) var. *lineata* (Ehrenberg) Van Heurck. Figs 10-11, valves with raphe-sternum. Figs 12-14, valves with sternum. Figs 10-11, 14, M-87/11 Provincia Villa Clara. Figs 12-13, M-479B, Provincia Matanzas. Scale 10 µm.

Figs 15-16. *Cocconeis placentula* (Ehrenberg) var. *euglypta* (Ehrenberg) Grunow. Valves with sternum. M-Ei Naranjo, Provincia Cienfuegos. Scale 10 µm.

to radial toward the apices, interrupted by a submarginal hyaline ring; 1-4 marginal areolae; areolae small, rounded, irregularly spaced on the stria, 16-26 in 10 μ m. In valves with sternum, the axial area is narrow; central area absent; striae 16-22 (24) in 10 μ m, composed of elongated areolae, 13-20 in 10 μ m, arranged in 6-10 (sometimes 5-13) undulating longitudinal lines.

Distribution: Taxon widely distributed in the country, often constituting dense populations. Found in: area n° 1 (M-88/17 and M-88/19); area n° 2 (M-73, M-76 Río, M-88, M-90, M-94, M-87-1, M-110, M-432b, M-87/5a, M-87/6, M-87/7, M-87/8 and M-87/9b); area n° 3 (M-479b, 480a); area n° 4 (unnumbered M-Naranjito-Cienfuegos); area n° 5 (M-87/11) M-431; area n° 7 (M-124b and M-131b).

Previously recorded from: Laguna del Tesoro, Matanzas and Jardín Botánico de Cienfuegos (Foged, 1984). Also described as *C. placentula* for Las Terrazas, Laguna los Negros, Laguna Blanquizaes, Laguna Vieja, Laguna Jovero, Laguna del Toro-Pinar del Río, Jardín Botánico Nacional-Habana, Presa Hanabanilla-Cienfuegos, by Maldonado & Genes (1986), and in Laguna de Mina Iberia, Guantánamo by Maldonado (1987); Jardín Botánico de Cienfuegos (Toledo, 1989); Presa La Fé and Río La Fé-Isla de la Juventud (Toledo, 1992a); Presa Jagüey, Charco en potrero, Río Saramaguacán, Presa Santa Cruz, Arroyo en camino a Presa Montesito, and Presa del Callejón de Carmen-Camagüey (Toledo, 1992b).

C. placentula Ehrenberg var. *euglypta* (Ehrenberg) Grunow Figs 15-16

Basionym: *Cocconeis euglypta* Ehrenberg, 1854: 194, pl. 34 (6A), fig. 2.

Grunow, A., 1884: 97, pl. 1(A), fig. 3.

Patrick R. & Reimer C.W., 1966: 241, pl. 15, fig. 8.

Krammer K. & Lange-Bertalot H., 1991: 87, pl. 49, fig. 3; pl. 50, fig. 1; pl. 53, figs 1-19.

Valves ovoid, relatively small, 9-22 μ m long and 6-12 μ m wide. The valve with raphe-sternum does not differ morphologically from those of var. *lineata*. The valve with sternum has a linear-lanceolate axial area; striae 18-22 in 10 μ m; the areolae are more elongated and further apart than in var. *lineata*, 10-12 in 10 μ m, in 3 to 5 very irregular longitudinal rows.

Distribution: populations of this taxon are composed of a small number of individuals. Found in: area n° 4 (unnumbered M-Rio Lojas, unnumbered M-El Naranjo); area n° 7 (M-116).

It had been previously reported for Laguna del Tesoro-Matanzas, Soroa-Pinar del Río, Playa Rancho Luna-Cienfuegos (Foged, 1984); Presa Jagüey and Río Saramaguacán-Camagüey, Turbera en Ciénaga de Lanier-Isla de la Juventud, (Toledo 1992a, b).

DISCUSSION

The presence of three taxa of the genus *Cocconeis* is reported for the continental water bodies of Cuba. *C. placentula* var. *lineata* and *C. placentula* var. *euglypta* were already known for various localities of the island, and in the present study their distribution is enlarged. *C. placentula* var. *pseudolineata* had not been previously known from the area under study, although Toledo (1992b) had found specimens from localities in Cama-

güey and reported then as *C. fluviatilis*. However, this latter species, first described in 1960 for freshwaters of the United States, differs from *C. placentula* var. *pseudolineata* in the morphology of the areolae on the valve with sternum: in *C. fluviatilis*, the areolae near the valvar margin are distinctly elongated, gradually becoming smaller and rounded toward the sternum. Valves with sternum of *C. placentula* var. *pseudolineata*, particularly the smaller ones, resemble valves of *C. neothumensis* Krammer and *C. neodiminuta* Krammer. Krammer & Lange-Bertalot (1991) stress that the main difference between these latter taxa and *C. placentula* var. *pseudolineata* is the presence of a lanceolate sternum, while in the var. *pseudolineata* the sternum is always narrow and linear. The valves with sternum of *C. placentula* var. *pseudolineata* collected in Cuba have a number of striae (10-13 in 10 µm) slightly less than the reported number for this variety (13-18 in 10 µm). However, the overall characteristics of the taxon, namely the rectangular to quadrangular transverse shape of the areolae and their arrangement on the valve, correspond well with the original description. Also, we were able to discern with light microscopy that the areolae have a highly refringent center, as described by Krammer & Lange-Bertalot (1991). This refringent center most likely corresponds to the reduced internal foramen.

Of the four taxa previously cited from freshwater bodies of Cuba, two were found in the material presently studied. The illustration of Maldonado & Genes (1986) for *C. placentula* appears to correspond to var. *lineata*. This taxon differs from the var. *placentula* basically by a fewer number of areolae on each stria on the valves with sternum. Foged (1984) also mentions *C. placentula* for Cuba, specifically for Laguna del Tesoro, but illustrations and dimensions were not provided. Two of the samples examined in the present study are from different locations in Laguna del Tesoro, yet only var. *lineata* was encountered. The citation of *C. fluviatilis* Wallace for Cuba (Toledo, 1992b) is an erroneous identification of *C. placentula* var. *pseudolineata*.

Without any doubt, we can state that *C. placentula* var. *lineata* is, within the genus, the most widely distributed taxon in the continental waters of Cuba: it was found in all samples analyzed, and very often in great abundance. *C. placentula* var. *pseudolineata*, as well as variety *euglypta* exhibit a more restricted distribution and the samples are characteristically lower in the number of individuals.

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